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Review

A systematic review of computer-based softwares for educating patients with coronary heart disease

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Abstract

Objective: To evaluate the use of computer-based softwares for educating patients with coronary heart disease.

Methods: A systematic electronic search for randomised controlled trials and comparison studies published from 1999 to the end of 2005 using the MEDLINE (1999–2005), EMBASE (1999–2005) and CINAHL (1999–2005) was carried out. Articles including the reference lists in the following journals were hand-searched: *Patient Education and Counselling* and *Patient Counselling and Health Education*.

Results: A total of 487 articles were identified. Based on a review of abstracts, five studies fulfilled the inclusion criteria of the review. A scoring sheet was used to assess the papers' quality. All studies reported significantly increased knowledge in patients using the educational software when compared to standard education. The difference in knowledge between the intervention and control groups remained high even at 6 months follow up. Furthermore, patients reported high satisfaction with the educational programs.

Conclusion: Despite there only being five studies that met the inclusion criteria, this review supports the successful use of computer software to increase knowledge in patients with coronary heart disease. The reviewed articles reveal that computer-based education has an important role in increasing patients' knowledge about their condition.

Practical implications: It is commonly reported that patients want more information about their illness. This study shows that computer-based education can be a useful, acceptable to patients and effective way to deliver education about coronary heart disease.

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Keywords: Patient education; Software; Coronary heart disease

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57 **1. Introduction**

58 Patient education is a combination of learning experi- 96
 59 ences influencing behaviour changes, producing changes in 97
 60 knowledge, attitudes and skills needed to maintain and 98
 61 improve health [1]. 99

62 There is an increasing pressure to provide more informed 100
 63 and standardized information resources to patients at less 101
 64 cost and the urgent need to provide structured educational 102
 65 interventions to enhance patients' health behaviour [2]. 103
 66 Improvement in patient knowledge about their illness and 104
 67 treatment could provide great benefits for both patients and 105
 68 their doctors. 106
 69

70 Patient education is an important factor in doctor-patient 107
 71 communication. A patient with a greater knowledge is more 108
 72 likely to engage in an active communication with their 109
 73 doctor [3]. Research showed that patients continue to be 110
 74 relatively uninformed about their condition and the 111
 75 appropriate treatment [4]. Receiving information during 112
 76 a medical encounter, evidence suggests that patients do not 113
 77 understand what is being said to them. This has been 114
 78 explained by cultural and educational gaps that exist 115
 79 between clinicians and patients. Kaptein and Wienman 116
 80 [5] found that although patients want more information they 117
 81 ask fewer questions in the consultation room. Encounters 118
 82 between doctor and a patient could potentially be used as a 119
 83 "teachable moment" [6]. However, physicians have little 120
 84 time for health promotion or patient education. 121

85 During the last decade, there has been an increase in 122
 86 educational computer-based technology and its use [7]. The 123
 87 benefits for using interactive educational packages are that 124
 88 patients have greater understanding of their condition, which 125
 89 then leads to better communication with the doctor to solve 126
 90 patients' problems [8]. Computerized educational systems, 127
 91 therefore, seem as an ideal opportunity for efficient patient 128
 92 education. This could also be beneficial for both doctors and 129
 93 patients, protecting them from the consequences of poor 130
 94 communication [9]. 131

95 Evidence shows that educational software can be 132
 96 beneficial for patients and also cost-effective than traditional 133
 134

100 means of education. Lewis [10] found that the use of 101
 102 technology is associated with improvements in patient 103
 104 satisfaction, better health outcomes, better compliance, 104
 105 more empowered patient decision making, and reduced 105
 106 medical malpractice as primary benefits. She identified 420 106
 107 titles and 66 of those met inclusion criteria for further 107
 108 investigation. Lewis concluded that computer-based educa- 108
 109 tion could be used as an effective strategy for transferring of 109
 110 knowledge and skill development for patients. Favorable 110
 111 results from using computerized educational systems have 111
 112 been reported across a number of health areas. 112

113 Davis [11] found that patients with cystic fibrosis 113
 114 reported enhancement in knowledge and coping strategies 114
 115 after using educational CD-ROM. 115
 116

117 Similarly, Wantland et al. [12] assessed the effectiveness 117
 118 of web-based versus non-web-based interventions. The web- 118
 119 based interventions compared to non-web-based interven- 119
 120 tions increased patients' knowledge and also led to 120
 121 behavioural change for outcomes variables, including 121
 122 increased exercise time, slower health decline and increased 122
 123 knowledge of asthma treatment. 123
 124

125 *1.1. Coronary heart disease*

126 The number of people suffering from coronary heart 126
 127 disease (CHD) is on the increase in the industrialized 127
 128 countries. It is a preventable disease that kills more than 128
 129 110,000 people in England every year. More than 1.4 million 129
 130 people suffer from angina and 275,000 people have a heart 130
 131 attack annually. CHD is the biggest killer in the country [13]. 131

132 The risk factors for CHD have been well known for many 132
 133 years. The effects of changing the risk factors on the 133
 134 incidence of the disease are well documented. Secondary 134
 prevention in terms of the medical treatment of the disease 135
 has become effective. Healthy lifestyles and effective 136
 management of risk factors also contribute to a better 137
 management of CHD. Primary prevention also remains a 138
 very important factor in reducing some risk factors, such as 139
 healthier diet, smoking cessation and more exercise. 140
 Research shows that even a small reduction in cholesterol, 141

134 smoking or blood pressure could have a dramatic effect on
 135 the number of deaths every year [14].

136 Patient education is an important component in the
 137 management and prevention of coronary heart disease. Past
 138 research shows that patients' beliefs and perceptions about
 139 their illness are key determinants of recovery after a
 140 myocardial infarction (MI) [15]. Patients who believed that
 141 their MI would have more long-lasting consequences had
 142 greater levels of illness-related disability and their return to
 143 work was slower. Similarly, patients who believed they had
 144 less control over their heart condition were found to be less
 145 likely to attend cardiac rehabilitation [16]. Education about
 146 CHD may be beneficial in changing health cognitions.

147 Research is beginning to show patient satisfaction for
 148 computerized education information. Stromberg et al. [19]
 149 found that heart failure patients aged 51-91 years were
 150 satisfied with the computer-based information and that they
 151 thought that it was a better way of receiving information than
 152 reading a booklet or watching a video about heart failure.
 153 The nurses reported that the patients were positive towards
 154 the computer and seemed to understand the information and
 155 that the patient education was less time-consuming, when
 156 the patients could seek knowledge on their own.

157 Given the fast-spreading usage and evaluation of
 158 computer-based educational programs, it is time to review
 159 the effectiveness of computerized educational software
 160 packages for coronary heart disease patients and their
 161 potential to increase knowledge in the long term. This will
 162 help service providers make decisions about computerized
 163 patient education delivery.

164 **2. Methods**

165 Computer software was defined as any interactive
 166 software that was used by patients for education about
 167 coronary heart disease, including CR-ROMs.

168 This review is based on searching the following databases
 169 from 1999 to 2005:

- 170 • MEDLINE (1999-2005).
- 171 • EMBASE (1999-2005).
- 172 • CINAHL (1999-2005).

173 The year 1999 was used to continue on from Lewis' [10]
 174 review of the computer-based approached to patient
 175 education.

176 The search strategy included the following terms:

- 177 (i) For the subject heading search, the term 'coronary heart
 178 disease' was exploded to include the following subject
 179 index terms—'cardiovascular diseases', 'heart diseases'.
 180 The subject heading of interactive learning included
 181 subject index term 'computer assisted instruction'.
- 182 (ii) For the free text search, terms of comput\$,
 183 evalu\$, assess\$, effective\$, efficacy\$, cardiac\$, CD-

184 ROM, computer-based education, computer patient
 185 education.

186 Hand searches were carried out in key journals (*Patient
 187 Education and Counselling* and *Patient Counselling and
 188 Health Education*) and reference lists were also examined.
 189 Using this search technique, an article that was published in
 190 1995 was identified [20]. As this article was not covered by
 191 Lewis' review [10] and it fulfilled the criteria for this review,
 192 it was decided that it should be included in the analysis.
 193 After identifying articles that fulfilled the criteria, the
 194 authors' names were re-entered into the search databases
 195 and crosschecked for any further studies.

196 Stromberg et al. [21] paper was also included despite it
 197 not being published yet. The author was unsuccessful in
 198 finding a particular full article that was eligible for this
 199 review. She, therefore, contacted the first author who kindly
 200 sent the updated version of the study and it was decided to
 201 include the most recent one.

202 The two authors assessed all selected studies indepen-
 203 dently for quality. A data extraction form was used to
 204 include studies in the review, with the maximum score of 20.
 205 The form assessed the following: (1) methodological quality
 206 of study including the study design (RCT versus compar-
 207 ison), study sample and selection and the measurement of
 208 the mode of delivery of a software; (2) intervention
 209 including type of comparison (comparison to standard
 210 material versus comparison to alternative material) and
 211 follow up duration; (3) analysis including the use of
 212 appropriate statistical analyses and drop out rates; (4) results
 213 and outcomes including the measurement of familiarity with
 214 computers, baselines measurements, patient outcomes
 215 (objective versus subjective), the measurement of satisfac-
 216 tion with the software and cost-effectiveness; (5) data
 217 analysis including analysis of confounding variables.

218 Abstracts of the 487 articles were read for relevance to
 219 the review. Full-text copies of five relevant articles were
 220 obtained.

221 **2.1. Study selection**

222 Studies were considered suitable for inclusion in the
 223 review if they met the following criteria.

224 **2.1.1. Participants**

225 Patients with coronary heart disease involved in studies
 226 where software was used.

227 **2.1.2. Interventions**

228 Computerized educational software, including CD-
 229 ROMs. The software could have been used by the patient
 230 alone or/and with a health professional. In order to be
 231 included in the study, the intervention had to be compared to
 232 either a standard or alternative materials.

233 Articles describing computer software that is aimed to
 234 educate health professional or students were excluded. Also

excluded were studies that were descriptive of the functionality of the software and studies that included web-based, email based, or telemedicine based educational programs.

2.1.3. Outcomes

All objective measures, regarding the evaluation of the effectiveness of the software, were considered. The main measure for the review was the change in knowledge before and after using the educational software and its comparison to a standard education.

2.1.4. Study design

Randomised controlled trials and comparison studies were included. Studies that do not provide adequate information regarding either a change in outcomes or the validity/reliability to the tool were excluded from the review.

3. Results

Of the 487 articles, 5 studies fulfilled the inclusion criteria [20-24]. The majority of articles that were excluded concerned software for educating professionals such as nurses or doctors. Some articles used computerized software for collection of information about heart disease education but not for actual education of patients. Articles that concentrated on the description of a development of educational software were also excluded.

The two authors assessed the five articles that met the inclusion criteria. Table 1 gives details about each article.

A scoring sheet was used to assess the papers' quality (see Table 2). The papers were scored on the methodological quality, intervention, analysis, results or outcomes and data analysis. The possible maximum score was 20 points. The reviewers compared their scores. Score were averaged for papers with a difference less than 2. One paper differed by more than one point and the disagreements were resolved by discussion about the discrepancy and the score was adjusted accordingly.

The total quality scores for each paper are listed in Table 1. The highest score is 15 and the lowest one is 12 (out of maximum 20).

3.1. Participants

The participants were all adults with coronary heart disease. No differences in age, aetiology, educational level or time of diagnosis were reported by either of the study. Jenny and Fai [23] indicated that some patients were not randomised for the trial, as they were not eligible because they needed to be seen by a specialist nurse first.

Table 1
Summary of review studies

	n	Time points of testing	Measurements	Age group (mean)	Control group education	Mode of delivery	Baselines measurement of knowledge	Drop out rates (intervention group) (%)	Quality scores
Jenny and Fai [23]	96	Pre- and post-testing; 2 months follow up	Written multiple choice quiz	58.8	Tutorial groups led by health-care professionals with transparency display of keywords and pictures	Group	Yes	33.3	13.5
Linne et al. [24]	130	4 weeks; 6 months	Written questionnaire	70.4	Leaflets	Individual	No	21.9	12
Consoli et al. [20]	158	Pre- and post-testing; 2 months follow up	Questionnaire; telephone questionnaire	50.4	Dialog with health professionals and pamphlets	Individual	Yes	12.7	13.5
Enzenhofer et al. [22]	112	Pre- and post-testing; 3 days follow up	Multiple choice questionnaire	56.9	Standardized conversation with health professional	Individual	No	12	14.5
Stromberg et al. [21]	154	1 month; 6 months	Knowledge and compliance questionnaires; quality of life questionnaire	70	Standard education received at a nurse-led heart failure clinic	Individual	Yes	12.2	15

Table 2
The scoring sheet used to assess the quality of the papers

	Maximum score
Methodological quality of study	
Study design (RCT = 2, comparison = 1)	2
Study sample and selection (good sample, well described = 2, good sample, not described = 1, low sample = 0)	2
The mode of delivery measured (yes = 1, no = 0)	1
Intervention	
Type of comparison (comparison to standard material = 1, comparison to alternative material = 0)	1
Follow up duration (6 months and more = 4, 3 months = 3, 1 month = 2, immediately after use = 1)	4
Analysis	
Statistical analyses used (appropriate yes = 1, no = 0)	1
Drop out rate (<25% = 1, >25% = 0)	1
Results/outcomes	
Familiarity with computers measured (yes = 1, no = 0)	1
Baseline measurements (yes = 1, no = 0)	1
Patient outcomes (objective = 2, subjective = 1)	2
Satisfaction with software measured (yes over 70% satisfied = 2, yes less than 70% satisfied = 1, not measured = 0)	2
Cost-effectiveness (yes = 1, no = 0)	1
Data analysis	
Discussed and analysed confounding variables? (yes = 1, no = 0)	1
Maximum total	20

3.2. Control group

The control groups all used standard education. Jenny and Fai [23] used a 30 min educational session led by health-care professional, using transparency display of keywords and pictures to a patients' group of 8-10 participants. There was also a 5 min of questions and answers. Linne et al. [24] used leaflets for educating the control group. Consoli et al. [20] used standard education consisting of dialog with physicians, nurses and dieticians together with pamphlets. Similarly, Enzenhofer et al. [22] used standardized

conversation and a brochure for the control group. Lastly, on follow up visit in a nurse-led heart failure clinic patient received standard education lasting approximately 1 h [21].

3.3. Learning

All studies commented on the fact that the computerized programs were easy to use even with elderly patients and with patients who had no previous knowledge of computers. Instructions given by the computer were described as short and easy to read and not containing scientific jargon. Jenny and Fai [23] reported that 85% of the adults in the intervention arm were computer illiterate.

To operate the CD-ROMs, patients used touch screen computers with large and clear buttons for easy handling [21,23], a computer mouse for which a nurse was available to help with its use [20] and a remote control [24].

The patients mainly used the software by themselves [21,23,24], or by themselves with a health professional available to help or answer any questions [20] or with a health professional [22] during which the patients were able to ask supplementary questions. When using the software alone, the patients were given test at the end of each chapter to check their own progress and were encouraged to repeat a chapter to answer all questions correctly [20,21,23,24].

3.4. Effect sizes

Effect sizes were computed on the available data (see Tables 3 and 4 for details) using the reported sample sizes, means and standard deviations. Effect sizes equal to or smaller than 0.50 were considered medium and effect sizes equal to or larger than 0.80 were considered large [25].

The overall effect size for the articles included in this review is 1.01. This is considered to be a large effect size. From the five research articles described in this review, four [21-24] had effect size larger than 0.50 and were therefore considered to achieve significant change in patients knowledge on coronary heart disease. This was true for studies that examined the knowledge change immediately after the procedure.

Effect sizes were calculated for the two studies that retested their subjects at 6 months after the intervention [21,24]. Even at 6 months follow up, the effect sizes of the two studies were larger than 0.50 and therefore considered to have a large effect (1.88 and 1.01, respectively).

Table 3
Change in the means and standard deviations in the intervention and control groups immediately before and after

Study	Effect size	Intervention group		Control group	
		Before	After	Before	After
Jenny and Fai [23]	1.13	7.25 (1.66)	9.10 (1.08)	6.96 (1.35)	7.54 (1.38)
Linne et al. [24]	0.56	N/A	17.2	N/A	14.3
Consoli et al. [20]	0.44	14.3 (4.2)	18.1 (3.6)	14.3 (4.2)	16.7 (3.2)
Enzenhofer et al. [22]	0.78	N/A	7.21 (1.6)	N/A	5.04 (2.8)
Stromberg et al. [21]	2.88	5.57	6.56	5.78	6.32

Table 4
Change in the means and standard deviations in the intervention and control groups at 6 months follow up

Study	Effect size	Intervention group		Control group	
		Before	After	Before	After
Linne et al. [24]	1.01	N/A	17.6	N/A	12.9
Stromberg et al. [21]	1.88	5.57	6.34	5.78	6.07

3.5. Satisfaction with the software

Three authors reported that the patients preferred the software to standard education methods [21–23]. Patients reported that the use of the software made learning more interesting, it supported self-paced learning and that it allowed more in-depth understanding. Positive comments were also made about the design and illustrations of the software tools [23]. Patients in the intervention group scored high on the satisfaction scale [22].

3.6. Age

Although the mean age in two studies was over 70 years (and over 50 years in the others), all patients were able to handle the software. Jenny and Fai [23] concluded that their software was suitable for elderly subjects as they enjoyed using the touch screen instructions. Stromberg et al. [21] pointed out that the handling of their CR-ROM was specifically designed with elderly patients in mind.

3.7. Gender

Consoli et al. [20] reported that women improved more than men on the knowledge test but this could have been due to their lower knowledge at the initial. Both men and women in the intervention group reported to have gained knowledge at 1-month follow up and a small decline in knowledge was noticeable at 6 months [21].

3.8. Drop out rates

The drop out rates varied from 12 to 33%. Drop out rates are described in detail in Table 1.

Jenny and Fai [23] believe that people who were lost to follow up at 6 months, nevertheless benefited from the initial educational training (either computer or standard) and that this lead to positive changes in their health and that they felt that they did not need further follow ups.

3.9. Knowledge

All authors reported increased knowledge after using either standard or computer-based education. However, the difference in knowledge was significant in the intervention groups compared to the control groups.

The difference in knowledge between the intervention and control groups remained high even at 6 months after the intervention [24]. The knowledge compared to the baseline was significant only in the intervention group [21].

The impact of increased knowledge on hospital admissions is not known.

3.10. Confounding variables

Authors reported several confounding variables. Although there had been an increase in knowledge in both groups, it is difficult to know whether this difference existed at the beginning of education. Jenny and Fai [23] believe that randomisation should have minimized this discrepancy. They also argue that in the patients in a pilot study scored low on knowledge pre-test. Similarly, no great improvement in compliance could have been explained by already high baseline level [21].

There might have been an unintended influence on the patients in the control group by the staff [23]. The authors described that after the educational session for the control group, there was time for questions and answers. This could have increased the group knowledge in a non-standard manner. In contrast, in the study conducted by Stromberg et al. [21], all participants received the same nurse-led education after which the intervention group used the computer for further education. Consoli et al. [20] also reported that a nurse could have influenced patients in the intervention group simply by their high enthusiasm and motivation.

3.11. Patients' empowerment

The software was reported to improve the doctor–patient communication [22]. It was observed that patients from the intervention group were asking more questions. This was especially true for patients with little knowledge of medicine. Computers helped patients to clarify and express their values and preferences, and this was true even if the physicians' values and preferences were different [22]. This finding is an interesting one in terms of patient empowerment. Knowledge in this case has led to patients' courage to ask questions about their condition. Patients and physicians will be able to make informed decisions about health matters. Further research is needed to establish exactly what role can computers play in this development.

4. Discussion and conclusion

4.1. Discussion

Although we only have data from five studies, this review demonstrates that computer software has the potential to be successfully used to increase knowledge in patients with coronary heart disease. It seems that computer-based

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education has an important role in increasing patients knowledge about their condition. Increases in knowledge are important for several reasons. Past research shows that knowledge is an important in effective disease management and is associated with increased self-efficacy [26]. Knowledge alone is not sufficient to produce changes in behaviour, however it appears to be a necessary component in the change process [27,28]. Stromberg et al. [21] could not detect any improvement in compliance with self-care and treatment. They believe that there is need for the computer education to be repeated in order to achieve behavioural change. Keeping in line with the current research [10], they also suggested that patient-tailored education is needed for greater effectiveness.

There are several advantages of using the computerized educational programs. Patients are allowed to study at their own pace, which means that this type of education is suitable even for people with lower educational level. In some studies patients were able to repeat difficult parts and interact with the content of the program [21,23]. This is useful for patients with different learning pace. Patients reported satisfaction with the software and its easiness to use. Computers were not found to be an obstacle for the interaction between the professional and the patients. It is believed to have improved the communication [22].

Enzenhofer et al. [22] reported that the advantages of running the software from a laptop is great as it could be brought to patients' bedside and help them to get the necessary knowledge about their condition. This can then subsequently help with patients' empowerment. Some worries were raised concerning the fact that by visualization of their condition could lead to raise patient's anxiety [29] but this was not found to be the case but does warrant further investigation. Similar findings were reported by Stromberg et al. [21].

There are also advantages to the standard education. In particular tutorial groups can give patients peer support and interaction [23]. Patients may prefer to be able to meet and discuss their problems with people who suffered similar problems. They might exchange their personal views and opinions on the illness. In the tutorial group, there is also time for questions and answers and this could highlight areas that might not have been covered in the actual training and it was suggested that computer education should be used alongside the tutorial method [23].

One needs to be careful in interpreting the results of this study. Gender imbalance (inadequate representation of women in particular) in research is widely reported in previous research [30]. Also, well recognised is the under representation of people from ethnic minorities and from low socio-economic groups [31]. Therefore, the results of the above review might reflect this imbalance. The future use of educational software must ensure that there is a fair distribution to all those who need them in particular people from disadvantaged groups.

It is commonly recognised that patients want more information. However, increase in knowledge does not

necessarily mean increase in issues that are important for successful management of a disease or a behavioural change.

4.2. Conclusion

There is strong evidence that the use of computer-based educational software improves knowledge in patients with coronary heart disease in the short term. The reviewed articles were very positive about using the computers for educating patients, given the patients' satisfaction and increase in knowledge about their condition. Only two papers reported outcomes at 6 months, therefore it is recommended that more research is needed to assess the longer-term impact of computerized education for CHD patients.

4.3. Practice implications

Computers are useful and well-received tool in coronary heart disease education. The age of the patient did not influence satisfaction in the studies in this review. Thus, suggesting that computerized education is appropriate for all age groups. Given that some patients may prefer the benefits of being able to ask questions or may become anxious by the visual graphics used by computer, patients should be given a choice about the usage of only receiving education from a computer. Future programmes should also consider adding a function to give patients immediate answers to their questions.

I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

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